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ENGAGE: A Game Based Learning and Problem Solving Framework (Task 1 Month 13)
Progress, Status and Management Report
Monthly Progress Report

Period Covered by the Report
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Technical Information

1. Technical Progress / Highlights - Observations

We are continuing planning efforts towards an "algebra challenge" event focused on Washington State. This challenge will encourage the use of DragonBox in early June. We have partnered with Technology Alliance, a statewide, not-for-profit organization of leaders from Washington's technology-based businesses and research institutions, to provide teacher training in the use of DragonBox as well as to help communicate our message to teachers. The front-end registration has been created, which will allow teachers to sign up for the challenge, and we have added features server-side to handle what we anticipate will be an unprecedented load. Specifically, we successfully separated the logging databases from other databases for performance and scalability, and performance caching scheme in place for retrieval of logging data is in progress.

Classroom observations at Greenlake Elementary were completed. We still need to conduct follow-up teacher interviews, but we are happy to note that the games were a hit with the students there. We are also continuing to work with Lowell Elementary to set up a trial. In partnership with WeWantToKnow, the original developers of DragonBox, we have run small trials of DragonBox in the UK and in Colombia.

We are still looking at the data from the first round at University Child Development School (UCDS), including the affect data. In particular, we are interested in the overarching distribution of concentrated moments (and sub-categories) and not concentrated moments and how they align with what is happening in the game, and looking for moments of trial-and-error (both successes and failures) and indications of strategies where game players get stuck. We are also interested to find what we could consider productive math engagement, specifically when that engagement involved "math talk".

There is a second round at UCDS currently scheduled for May, and we are working on adding features to the Creature Capture game in order to study "math talk" in more depth. In this new trial, students will pair up into teams of two sharing one computer (they will take assessments before and after on their own computers). The teams will be paired against each other as opponents. A team of two students will play the game together against another team of two students who are on the other side of the table. There are two roles per team, the Driver (who controls the mouse) and the Explainer. Every few levels, a screen will pop up to have the students switch roles. The idea will be to study how the students communicate with each other and work together. We selected Creature Capture for this particular trial as it was observed to have caused the most discussion of math in the first UCDS trial.

We have begun development on a new game, temporarily called "Algebra Adventure," that presents players with a set of inter-linked algebraic challenges tied together by a generated story. This project aims to enable the solving of Algebra I word problems through a DragonBox-like interface. The story and the game challenges are automatically generated from a choice of educational topic and theme (i.e., a student may pick the world he or she would like to learn in, such as a medieval fantasy world, or a science fiction world). Story characters and their relationships are used to create problems with linear equations that the player must both identify and solve. A correctly solved equation produces a value that advances the player to the next step of the adventure. The problems are connected, so that the results of one problem can be used as inputs in others, creating a chain of interlinked challenges. The problem difficulty can be automatically adjusted for each student.

2. Results or Problems and Solutions

We have continued to iterate on DragonBox in advance of the Algebra Challenge. We have created tiles that do not use cursive style lettering (potentially confusing for students in the US, where cursive is falling in use), and fixed various bugs. We have also more tightly integrated DragonBox and the Teacher Portal, so that teachers can assign specific sets of levels to students by using the Teacher Portal.

We also worked on a "line by line" mode for more complex equations that capture manipulations of the equation in a history view, akin to "showing your work" on pen-and-paper algebra tests. The line by line mode allows us to encourage students to take the correct number of steps to solve each algebraic problem and, we hope, improve transfer to test situations.

We have been working through many initial design issues with the Algebra Adventure, including the optimal length of one gameplay session, the number of inter-linked problems, and the relationship between "solving" and "evaluation," also describable as "manipulating equations" and "manipulating expressions." Our general approach is to provide different actions depending on whether the player is working with an expression or a whole equation. These two are, in turn, meant to work together in order to produce the satisfying result of finding a solution to the mystery opened at the beginning of the "adventure".

3. Significant Accomplishments Anticipated During Next Reporting Period

- Preparations for Washington State Algebra Challenge complete
- "Algebra Adventure" in playable beta form
- Analysis of data from Greenlake
- UCDS Round 2 and Lowell trials completed

4. Publications relevant to this effort

"A Trace-based Framework for Analyzing and Synthesizing Educational Progressions"
Erik Andersen, Sumit Gulwani, and Zoran Popović. *CHI 2013* (Paris, France), April 27 - May 2, 2013.

"Learning Fractions Through Splitting in an Online Game"
Stephanie Baker Peacock, Carmen Petrick Smith, Taylor Martin, Ani Aghababyan, Zoran Popović, Erik Andersen, and Yun-En Liu. *American Educational Research Association Annual Meeting (AERA 2013)* (San Francisco, California), April 27– May 2013.

5. Meetings and Events (Please include meetings with subcontractors)

ENGAGE PI Meeting, March 5-6, Arlington, Virginia

6. Changes to the Contract Organization

None.